

Soaring to New Heights: Revolutionising Mobile Network Testing and Coverage with Drone Technology

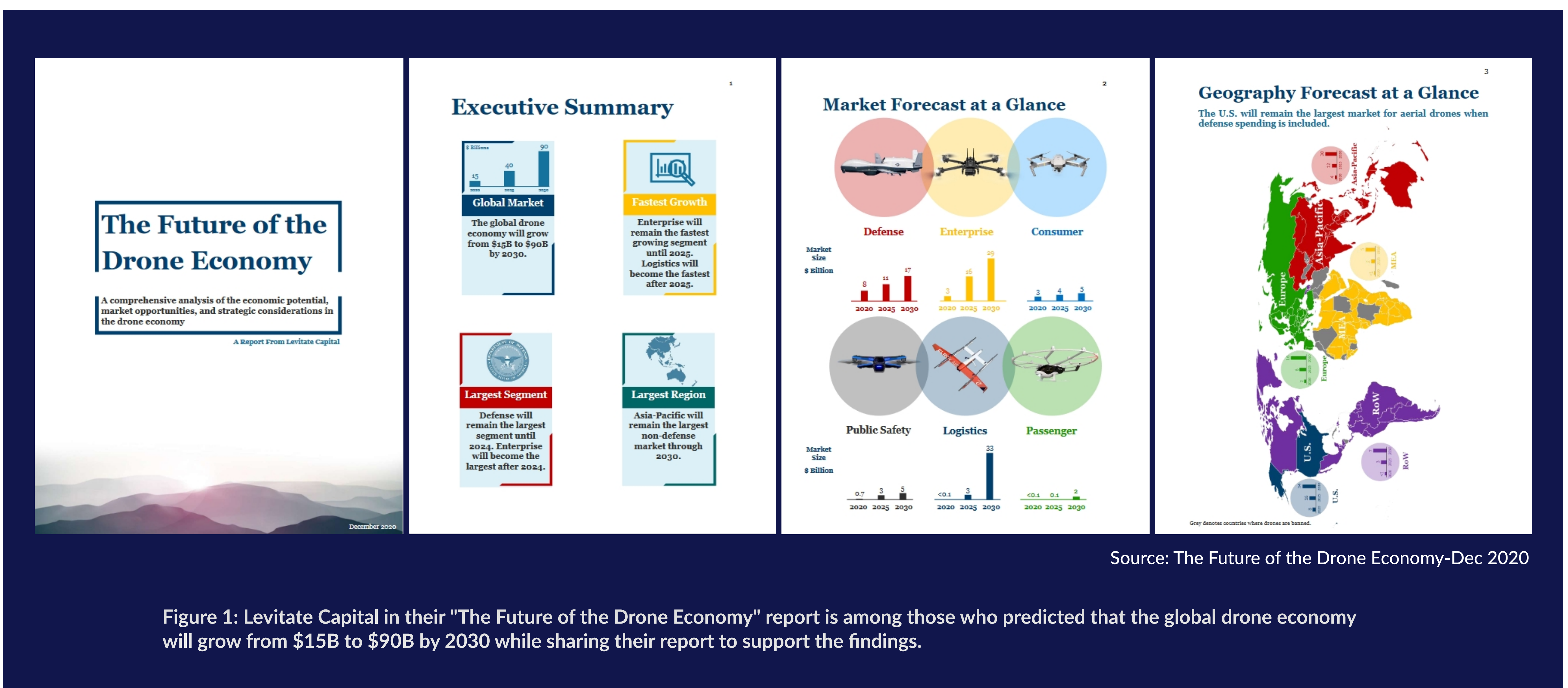
Leveraging drones in achieving efficiency, accuracy & cost-effective network optimisation.

White Paper

Executive Summary

This white paper explores the transformative potential of drone technology in mobile network testing and coverage enhancement.

As the global drone economy is projected to grow from \$15B to \$90B by 2030, mobile network operators (MNOs) increasingly leverage this technology to improve efficiency, reduce costs, and enhance network performance.



Critical applications include base station inspection, coverage testing, and innovative solutions like AT&T's Flying COW (Cell on Wings).

The paper also introduces **SiERA Donor Finder**, a cutting-edge solution for optimising LTE repeater and fixed wireless access (FWA) deployment. By adopting drone-based solutions, MNOs can achieve more accurate, safe, and cost-effective network optimisation, paving the way for improved connectivity and service quality.

“The global drone economy will grow from \$15B to \$90B by 2030.”

- Levitate Capital report

Introduction

Drones have been widely used in various industries nowadays.

From the delivery of goods to the photography and filming industry, the applications of drones are becoming more significant and have gained interest due to their advantages. In agriculture, drones have been used to spray insecticide in plantations, such as palm oil, as an alternative to the traditional method, which field workers previously did [1]. Drones are also used in crop or plant monitoring to prevent disease infection [2]. In these use cases, the main advantage of using drones is the ability to quickly and easily access or survey large plantation areas.

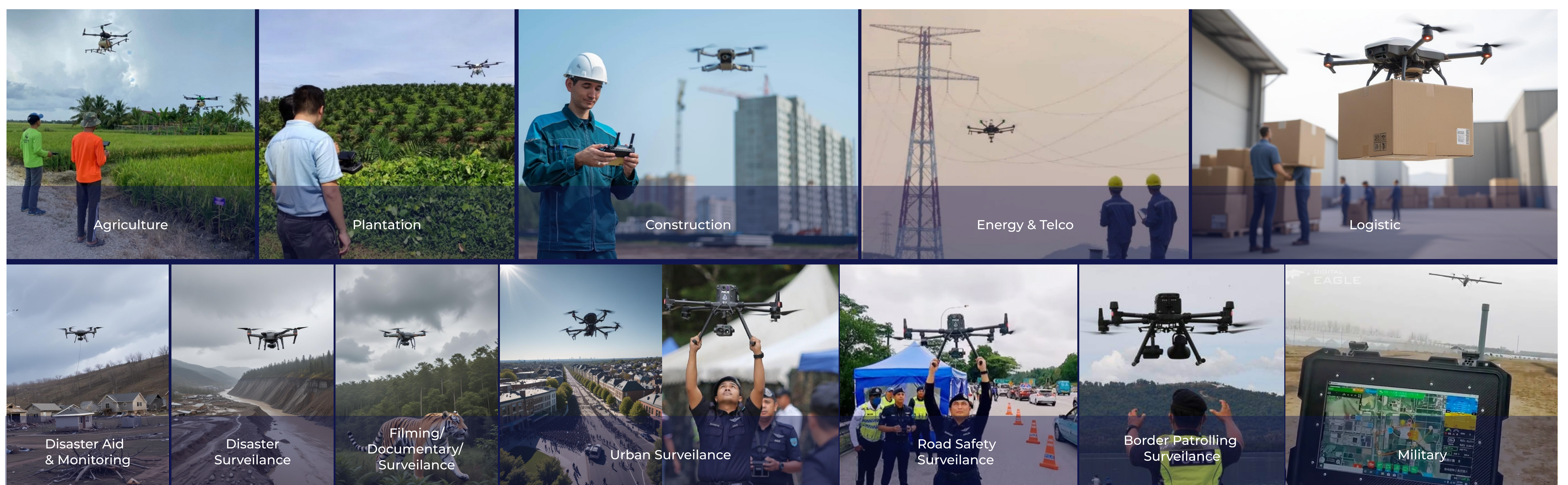


Figure 2: Drone application examples in today's industries.

In the construction industry, drones are used to survey construction sites and perform site planning. Additionally, drones also help perform progress tracking, including monitoring contractors and tracking material and equipment [3, 4]. The use of drones allows visual data to be obtained accurately and fast. Moreover, using drones to perform site surveys reduces the worker's exposure to risk (e.g. height, chemical exposure, heat exposure), thus improving the health and safety conditions at the construction site.

According to a report from Levitate Capital, the global drone economy will grow from \$15B to \$90B by 2030 [5]. With artificial intelligence (AI) driving the core value of drone technology, more commercial applications of drones can be expected. AI will empower drones to operate more intelligently, be more adaptive to dynamic environments, and perform more complex tasks.

“Drones overall will be more impactful than I think people recognise, in positive ways to help society.”

- Bill Gates, founder of Microsoft

Opportunity for Mobile Network Operators

Mobile network operators (MNOs) use base stations or cell towers daily. Before a tower is constructed at the site, a survey must be conducted to determine the location of the tower, which heavily depends on the network coverage assessment at that location. When installing a base station, accurate measurement of the tower, detailed location and position of the equipment (altitude, latitude, longitude), and information such as available tower space must be available to the installer. Once commissioned, the base station requires regular maintenance work.

Drones are changing the way MNOs carry out inspections and maintenance work [6, 7]. For all of the above-mentioned procedures, drone technology can make business more manageable for MNOs.

Drones equipped with high-resolution cameras and GPS devices can produce better-quality images and videos of the tower and its surroundings with accurate and precise location information for site surveys and radio planning.

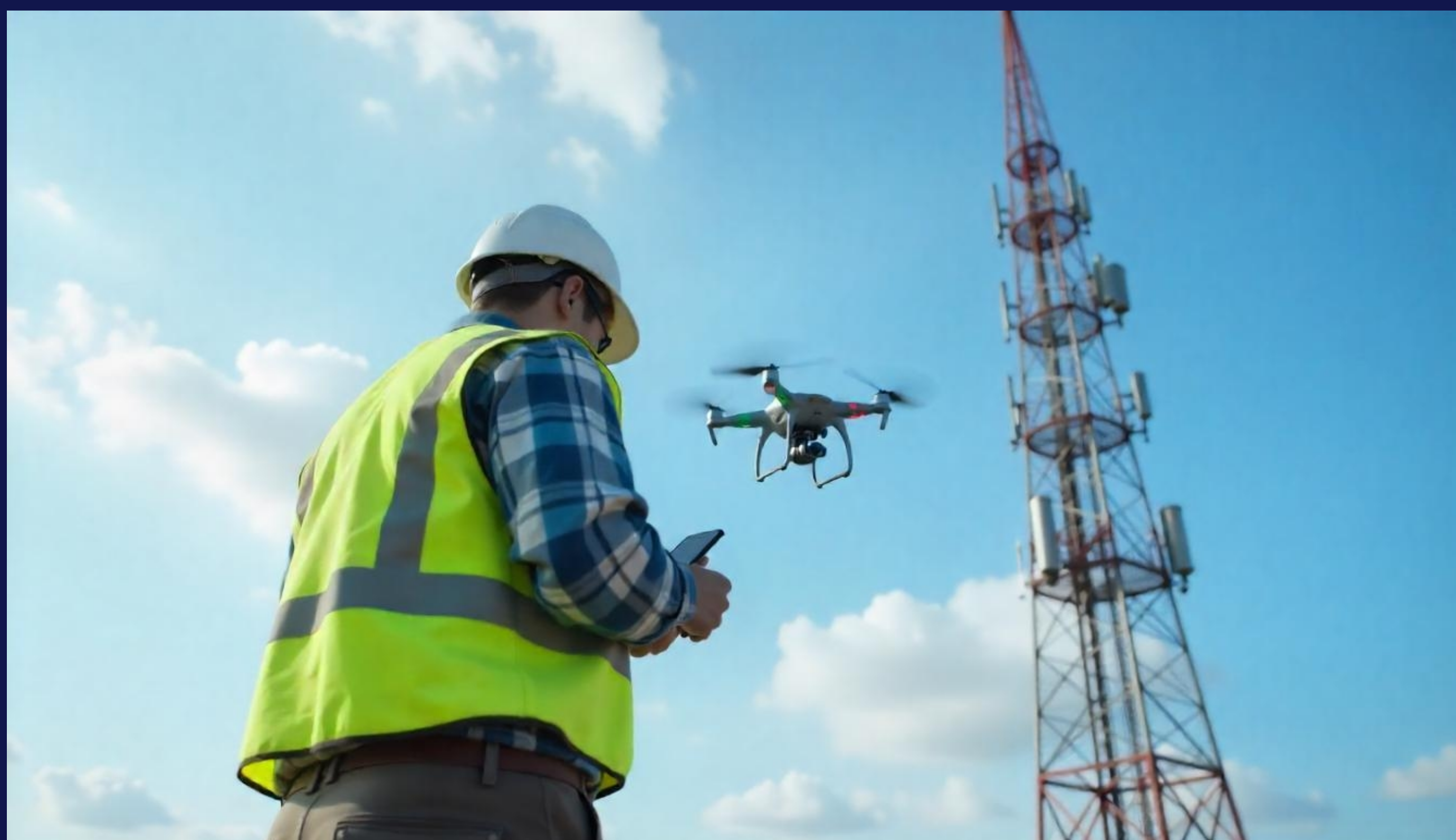


Figure 3: Telco tower inspection/surveillance via drone (left) and simultaneous supervision by monitoring team (right).

In addition, compared to hiring technical personnel to climb the tower, which involves hazardous situations, drones can perform routine tasks safer and faster. Moreover, before installing the equipment, drones can identify any possible defects or changes in the tower compared to previous surveys.

When it comes to maintenance work, data collected using drones can be analysed in real-time operation. Therefore, inventory or asset records can be checked faster and more efficiently.

Opportunity for Mobile Network Operators - cont.

Beyond the use case of drones involving base stations and tower management, AT&T has used drones to provide mobile 5G hotspots [8]. Known as Flying COW (Cell on Wings), AT&T provides 5G coverage of approximately 10 square miles to an area that previously had no service coverage. This achievement is familiar to AT&T since they have tested this concept with LTE [9].

Small cells and antennas are attached to the drone to provide LTE coverage from the sky to customers on the ground.



Flying COW is helpful since it can be deployed in remote areas where wired and wireless infrastructure services are unavailable. Crucially, it can provide connectivity to emergencies or disasters, such as rescue missions. In a less critical application, flying COW can enhance mobile coverage at significant events such as festivals or sports.

Coverage and Signal Strength Measurement

Coverage data of mobile networks are typically collected on the ground using drive or walk test scanners. The coverage data contains key performance indicators (KPIs) such as reference signal received power (RSRP), reference signal received quality (RSRQ), and signal-to-interference-plus-noise ratio (SINR). MNOs use these data to perform network planning and optimisation and ensure that the network plan complies with local regulatory standards.

As drone technology continues to progress, major MNOs like AT&T and US Cellular are using drones to conduct coverage testing to assess the performance of their networks [10, 11]. Drones are used to check for weak signals or dead zones in particular areas and to check network connectivity at different altitudes, both in the air and on the ground.

SiERA Donor Finder

SiERA Donor Finder is an innovative solution developed by TM R&D that effectively finds donor base stations for LTE repeater or fixed wireless access (FWA) deployment. SiERA Donor Finder comprises a wideband directional antenna and a mobile scanner. It comes with a mobile app enabling users to access the mobile scanner for instant data collection during scanning.



Figure 5: SiERA Donor Finder (Module and Mobile App).

Efficient Cell Scanning with SiERA Donor Finder

The directional antenna is designed with high gain and wide bandwidth to enable thorough signal scanning to find base stations near the point of interest. Its frequency range is from 700MHz to 3800MHz. The mobile scanner is a SIM-based scanner that supports all LTE bands in Malaysia. The scanner provides a band lock option, in which such features will allow the selection of a particular LTE band for a specific MNO.

Mounted on a drone, SiERA Donor Finder can perform cell scanning at the expected height of the repeater's or FWA's installation location for LTE KPI measurement. This allows for accurate data collection and analysis since measurement is done at the location or close to the location where the final equipment will be installed.



Figure 6: SiERA Donor Finder mounted on a drone.

Efficient Cell Scanning with SiERA Donor Finder - cont.

The mobile app is designed with an algorithm that helps installers select the best donor base station for the repeater or FWA deployment. When scanning for a potential donor, SiERA Donor Finder will measure the LTE KPIs and signal throughput at the specific location. Based on these parameters, analysis will be carried out to determine the best donor that provides good signal quality with acceptable resource utilisation.

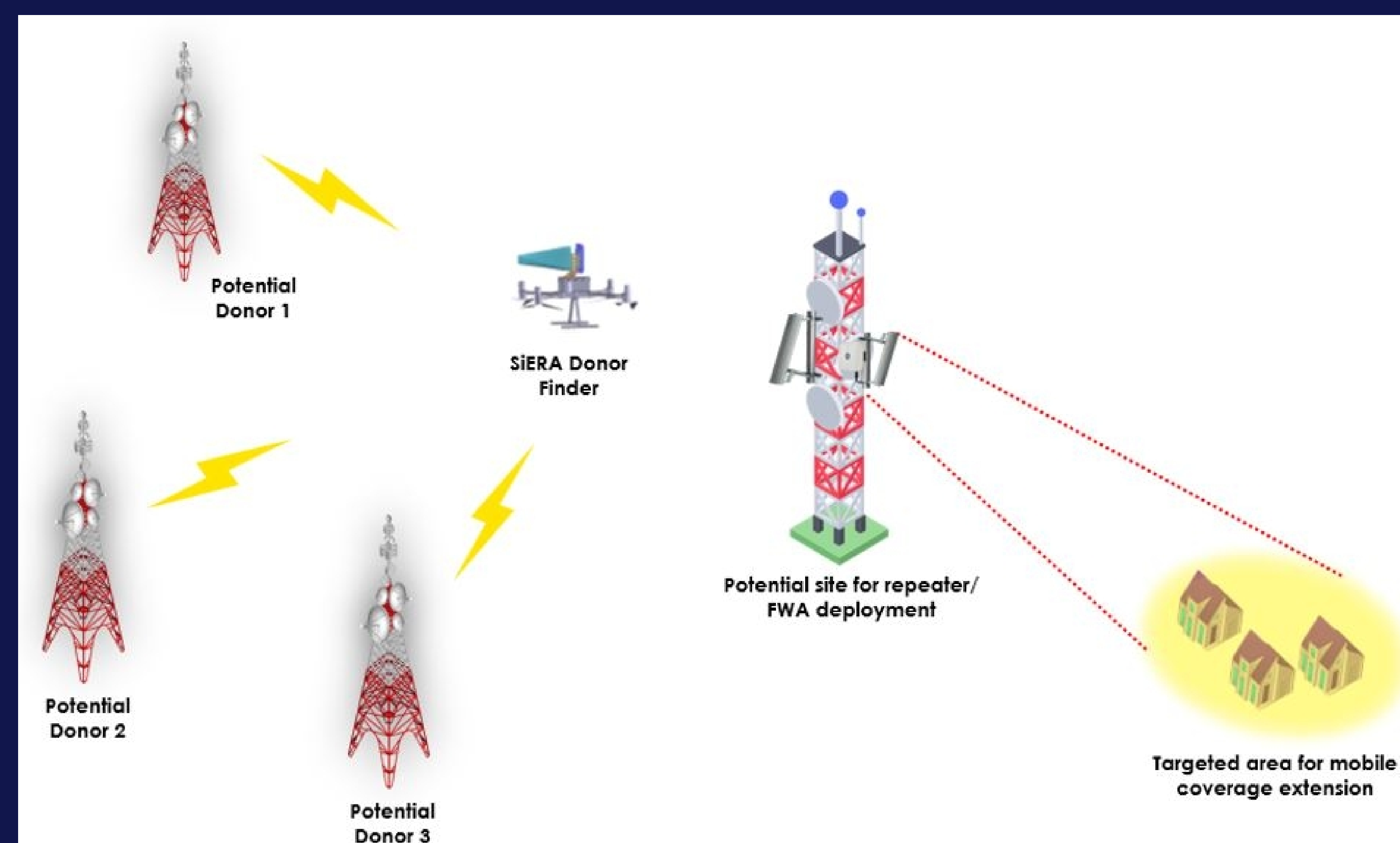


Figure 7: Using SiERA Donor Finder in finding donor base station.

SiERA Donor Finder had been used in the repeater deployment project at sites in Kampung Chuah and Royal Seri Menanti Golf & Country Club, Negeri Sembilan.

Using drones, it was proven that cell scanning could be done faster and more flexibly than manual scanning since measurement is no longer constrained by height.

In addition, cell scanning can be done where a tower or structure is not present. In these projects, repeater installation was carried out based on the recommendation provided by SiERA Donor Finder. The repeater deployment project at both sites was successful as coverage and Quality of Service (QoE) were significantly improved.



Figure 8: SiERA Donor Finder was used for cell scanning at Royal Seri Menanti Golf & Country Club, Negeri Sembilan.

Cost-Benefit Analysis

Implementing drone-based solutions for mobile network testing and optimisation can lead to significant cost savings and efficiency gains for MNOs [12, 13]. Traditional methods of network testing, such as drive tests and manual tower inspections, are time-consuming, labour-intensive, and often require specialised vehicles and equipment.[14]

By adopting drone technology, MNOs can expect:

1. **Reduced labour costs:** Drones can perform tasks that previously required multiple technicians, often in less time.[15]
2. **Increased safety:** By minimising the need for workers to climb towers or access difficult terrain, workplace accidents and associated costs can be reduced.[13, 16]
3. **Faster data collection:** Drones can cover large areas quickly, allowing for more frequent and comprehensive network assessments.[12, 14]
4. **Faster data collection:** High-resolution cameras and precise GPS positioning provide more detailed and accurate data than manual methods.[13, 15]
5. **Flexible deployment:** Drones can be quickly deployed to assess network performance during special events or emergencies, reducing response times and improving customer satisfaction. [12, 16]

While the initial investment in drone technology and training may be substantial, the long-term benefits in terms of operational efficiency and data quality can provide a strong return on investment for MNOs.

“I think drones are a good tool to go after high-values targets.”

- Michael Thomas McCaul

American attorney, politician and a member of the U.S. House of Representatives for Texas's 10th congressional district. A member of the Republican Party, he chaired the House Committee on Homeland Security during the 113th, 114th, and 115th Congresses.

Conclusion

The integration of drone technology presents a great opportunity for mobile network operators to address challenges in mobile network testing and coverage enhancement. By leveraging drones equipped with our SiERA Donor Finder solution, operators can achieve greater efficiency, accuracy, and cost-effectiveness in their network optimisation efforts, particularly in repeater or FWA deployment.

As the technology continues to evolve, we can expect to see even more innovative applications of drones in the telecom industry. From AI-powered autonomous network optimisation to the support of advanced 5G and future 6G networks, drones are set to play a crucial role in shaping the future of mobile connectivity. However, as MNOs embrace these opportunities, they must also navigate the complex regulatory landscape and address potential challenges related to privacy, security, and environmental impact.

By striking the right balance between innovation and responsibility, mobile network operators can harness the full potential of drone technology to deliver better, more reliable, and more sustainable mobile services to their customers. As we soar into this new era of network testing and optimisation, the sky is truly the limit for what drones can help us achieve in the world of mobile communications.

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Established in 2000, TM R&D is the innovation arm for TM Group focusing on creating smarter ecosystems to make business and life easier for a better Malaysia. TM R&D's solutions are clustered around four (4) pillars namely Intelligent Platforms, Data Brokerage, Connectivity/Tools and IR4.0/Digital Solutions.

Growing from strength to strength since 2016, TM R&D has won multiple global awards and generated more than 2,800 Intellectual Property Rights (IPRs) and 1,400 digital assets to-date.

TM R&D's innovations are all developed in-house and cut across multiple verticals such as Utilities, Retail, Agriculture, Healthcare and Education with safety and productivity as the top priority.

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